Biological Data-Based Actomyosin Complex Detection

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Abstract: This paper describes that actomyosin complex particles are automatically detected. Myosin is the best studies molecular motor. Information on the myosin bound to actin can be obtained using cryo-EM. Since actomyosin complex shape is complex, its feature extraction is very difficult. We propoe a new approach which combines Gabor feature selected by AdaBoost with SVM classifier to detect actomyosin complex particles automatically. The automatic detection system is made up of two major parts of three stages cascade of classifiers and SVM. In the cascade, the weak classifier is a binary classifier and AdaBoost is to select a few important features, which reduces input vector representation for training SVM. Three stages cascaded classifier is to retain information about the continuous outputs of each feature detector rather than converting to binary decision. The second part is composed of SVM that is used for the final classifier to implement binary classes.

Actomyosin image resolution in cryo-EM is 1.72Å/pixel, size is 2048×2048 pixels with 16bit gray level. We design a 210×210 pixels window, which are rotated at 45 degrees increments to obtain actomyosin images totaled up to 1450. Actomyosin particle detector window is scaled to 42×42 pixels as sub-window using sub-sampling approach. Actomyosin particle feature is represented using Gabor filter banks at eight orientations and five spatial frequencies. A total Gabor filter features selected by AdaBoost procedure are 215. Experimental results show that the detection rate achieves 95.62%, the false positive rate is 1.79%, the false negative rate is 4.42%, and a total rate of 97.28% of examples that were correct classified. Compared with three ROC curves, Ada-SVM is best classifier. Our approach can extract asymmetrical particles and a variety of irregular particles. Also, this approach represents progress which macromolecule particles in cryo-EM image are detected automatically.